

# **NEV AMERICA: NEIGHBORHOOD ELECTRIC VEHICLE (NEV) TECHNICAL SPECIFICATIONS**

**Revision 1  
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## **MINIMUM VEHICLE REQUIREMENTS**

The NEV America Program is sponsored by the U.S. Department of Energy Office of Transportation Technology to provide for independent assessment of Neighborhood Electric Vehicles (NEVs). For purposes of the NEV America Program NEVs are considered to be pure electric vehicles intended for on road use as low speed vehicles meeting the requirements of 49 CFR 571.500. Vehicles tested under this Program are evaluated against specific qualitative and quantitative metrics. The results provide potential users a method for comparing various NEVs against consistent standards and against each other. Comparisons that might not otherwise be possible. The U.S. Department of Energy recognizes the NEV America program as requisite for funding of programs involving NEVs.

For a vehicle to be considered qualified for testing under the NEV America Program, it must comply with the minimum criteria defined by “shall” terminology utilized in the Specification. [For clarity, the use of the word “Shall” defines minimum requirements, whereas the use of the word “Should” defines design and performance objectives.] Vehicles that do not or cannot comply with all of the “Shall” requirements will be considered Prototypes, and will not be considered as having successfully completed the Program. The following requirements have been extracted from the body of the Vehicle Specification for convenience and clarity. In these requirements and in the Vehicle Specification, the term “Supplier” refers to the vehicle manufacturer. All of the following requirements must be met by any vehicle before it can receive consideration under the NEV America Program.

- (1) Vehicles shall comply with Federal Motor Vehicle Safety Standard 500 as promulgated on the date of manufacture. Such compliance shall be certified by the Supplier in accordance with 49 CFR 567.
- (2) Suppliers shall provide a completed copy of Appendix A and Appendix B with their proposal providing vehicle specifications and the method of compliance, if any, with each listed section of 49 CFR 571.100.
- (3) Vehicles shall be certifiable under current California Air Resources Board (CARB) regulations as vehicles that meet ZEV emission requirements and qualify for ZEV credits. If the vehicle is equipped with a fuel-fired heater, the heater shall also comply with this requirement.
- (4) Suppliers shall provide Material Safety Data Sheets (MSDS) for all unique hazardous materials supplied with the vehicle.
- (5) Suppliers shall provide recycling plans for batteries and other vehicle hazardous materials including how the plan has been implemented.

- (6) All vehicles shall comply with the FCC requirements for unintentional emitted electromagnetic radiation, as identified in 47 CFR 15, Subpart B, "Unintentional Radiators."
- (7) Vehicles shall have a minimum payload of at least 400 pounds.
- (8) Suppliers shall provide the curb weight and rated payloads of their vehicles.
- (9) For conversion vehicles, Suppliers shall specify the OEMs gross vehicle weight rating (GVWR) and shall not exceed such rating.
- (10) For conversions, OEM Gross Vehicle Axle Weight Ratings (GAWR) shall not be increased.
- (11) Suppliers shall provide axle weights for the vehicle as delivered, and at full rated payload.
- (12) Odometers shall be provided and shall have an accuracy of at least  $\pm 5\%$ .
- (13) The Supplier shall offer a standard or an optional tire conforming to the following requirements:
  - Tires provided shall correspond to the requirements of the placard installed in accordance with 49 CFR 571.109, and 110, as applicable.
  - Suppliers shall specify manufacturer, model and size of the standard tire for the vehicle and for the tire provided.
  - Tire size and inflation pressure for the tire provided shall be in accordance with the requirements of the placard.
  - At no time shall the tire's inflation pressure exceed the maximum pressure molded into that tire's sidewall.
  - The tire provided shall be operable across the entire operation/load range of that vehicle.
  - Replacements for the tire provided shall be commercially available to the end user in sufficient quantities to support the purchaser's needs.
  - Tires provided as original equipment by the Supplier shall not have warranty restrictions in excess of those of the tire's manufacturer, unless the Supplier provides the warranty for the tires.
- (14) Seating capacity shall be a minimum of 1 driver. Suppliers shall specify seating capacity (available seat belt positions) for their vehicle. If a conversion vehicle's seating capacity is changed from that specified by the OEM on their FMVSS placard, the seat(s) being added or abandoned shall be modified as required by 49 CFR 571.207, et al, and a new FMVSS placard installed as required by 49 CFR 567, 568 or 571, as applicable.
- (15) For conversion vehicles, the OEM passenger space shall not be intruded upon by the batteries or other conversion materials.

- (16) The controller/inverter shall limit the maximum battery discharge to prevent degradation of battery life (see Section 6.3) and abrupt loss of vehicle operability or shall indicate to the vehicle operator that the battery will be damaged by continued vehicle operation. Such limit and/or indication shall be repeatable and accurate to at least 10% battery state of charge.
- (17) Regenerative braking shall not adversely impact the vehicle's service brake capability on varying road surfaces.
- (18) Vehicles shall comply with the requirements of 49 CFR 571.105.S5.2.1, or alternatively, 49 CFR 571.105.S5.2.2 for parking mechanisms
- (19) The vehicle top speed shall not exceed 25 mph when tested in accordance with 49 CFR 571.500.
- (20) Vehicles shall be capable of completing the NEV America Handling Test NTP-004 Revision 1 and Rough Road Test NTP-005 Revision 1 including (1) driving through two (2) inches of standing water at a speed of 20 mph without damage and without battery to chassis leakage current exceeding 0.5 MIU per UL Standard 2202, and (2) standing for extended periods in extreme temperatures without damage to or failure of the vehicle or its systems. Vehicles should be capable of completing the NEV America Rough Road Test NTP-005 Revision 1 without becoming inoperable.
- (21) Vehicle shall be capable of completing all NEV America tests without repairs exceeding a cumulative total of 72 hours.
- (22) If vehicle batteries require active ventilation for charging, the vehicle shall be so marked.
- (23) Suppliers shall indicate the depth of discharge below which the batteries should not be discharged.
- (24) Suppliers shall provide a description of areas of non-compliance (if any) with the requirements of Section 6.5.
- (25) Concentrations of explosive gases in the battery box shall not be allowed to exceed 25% of the LEL (Lower Explosive Limit).
- (26) Suppliers shall describe how battery boxes will be vented, to prevent battery gas accumulation during and following normal charging, abnormal charging and operation of the vehicle.
- (27) Suppliers shall provide a description of areas of non-compliance (if any) with the requirements of SAE J1718 on Battery Gas Evolution.
- (28) Maintenance requirements for the batteries shall be described and any associated cost(s) to the consumer/end user should be clearly defined.

- (29) Vehicles shall not contain exposed conductors, terminals, contact blocks or devices of any type that create the potential for personnel to be exposed to 60 volts or greater (the distinction between low-voltage and high voltage, as specified in SAE J1127, J1128, et al.).
- (30) Access to any high voltage components shall require the removal of at least one bolt, screw, cover or latch.
- (31) Devices considered to be high voltage components shall be clearly marked as HIGH VOLTAGE.
- (32) Cable and wire marking shall consist of orange wire and/or orange sleeves as identified in SAE-J1127.
- (33) Propulsion power system operating at greater than 60 volts shall be isolated from the vehicle chassis such that leakage current does not exceed 0.5 MIU.
- (34) Charging circuits shall be isolated from the vehicle chassis such that ground current from the grounded chassis does not exceed 5 mA at any time the vehicle is connected to an off-board power supply and shall be compatible with operation using a 5 mA GFCI..
- (35) Vehicles using HIGH VOLTAGE traction systems shall be equipped with a key operated “master” switch that shall interlock controller propulsion functions and battery contactor(s), if any, to render the propulsion system inoperative. Contactor(s) used in conjunction with the master switch shall be capable of interrupting maximum rated controller/inverter current.
- (36) A manual service disconnect for vehicles using a HIGH VOLTAGE traction system shall also be required. It shall have the following characteristics;
  - Manual action is required to break the connection,
  - The disconnection is physically verifiable,
  - The disconnection does not create exposed conductors capable of becoming energized while exposed, and
  - The service disconnect is marked so as to be visible from outside the vehicle with the doors (if so equipped) open and is accessible without the use of tools.
- (37) The following controller/inverter interlocks shall be present:
  - The controller shall not initially energize to move the vehicle with the direction selector in any position other than “PARK” or “NEUTRAL,”
  - The master switch key shall be removable only when the switch is in the “OFF” position, and
  - With a pre-existing accelerator input, the controller shall not energize such that the vehicle can move under its own power in this condition.

- (38) The vehicle shall be prevented from being driven with the master switch key turned on and the drive selector in the drive or reverse position while the vehicle's charge cord is attached.
- (39) Electrically powered windshield wipers shall be provided as standard or optional equipment.
- (40) An electrically powered warning horn operable by the vehicle driver shall be provided as standard or optional equipment.
- (41) Vehicles shall be equipped with an on-board or off board battery charger capable of recharging the propulsion battery to a state of full charge from any possible state of discharge in less than 12 hours.
- (42) The charger shall be fully automatic, determining when "end of charge" conditions are met and transitioning into a mode that maintains the propulsion battery at a full state of charge while not overcharging it, if continuously left on charge
- (43) On-board and off board chargers shall have the capability of accepting input voltages of 120V (Level 1), 208V or 240V (Level 2) single phase 60 Hertz alternating current service, with a tolerance of  $\pm 10\%$  of rated voltage.
- (44) On-board charger personnel protection systems, which may include ground fault circuit interrupters (GFCI), shall be in accordance with the provisions of UL Standards 2202.
- (45) Level 2 charge connector shall comply with the requirements of UL Proposed Standard 2251.
- (46) Regardless of the charger type used, the charger shall conform to the requirements of UL Proposed Standard 2202.
- (47) Suppliers shall specify all optional equipment required to meet the requirements of this Vehicle Specification.
- (48) Vehicles shall be accompanied by non-proprietary manuals for parts, service, operation and maintenance, interconnection wiring diagrams and schematics.

The following sections constitute the Technical Requirements of the Vehicle Specification. Information has been categorized according to component and/or function. These sections provide an overview of the requirements and recommendations for Suppliers to use. This Technical Specification establishes the minimum requirements for Production level Neighborhood Electric vehicles, as well as identifying design and performance objectives.

No inference should be drawn by Suppliers or any other person that the measures listed in this specification are sufficient to make the vehicle safe, and each Supplier shall acknowledge **in writing** that 1) it is solely responsible for determining whether each vehicle offered for sale is safe, and 2) it is not relying on Electric Transportation Applications, or the U.S. Government as having, by this specification and its requirements, established minimally sufficient safety standards. This written statement shall be provided with the Supplier's submittal.

## **1.0 REGULATORY REQUIREMENTS**

### **1.1 FMVSS CERTIFICATION**

Vehicles shall comply with Federal Motor Vehicle Safety Standard 500 as promulgated on the date of manufacture. Such compliance shall be certified by the Supplier in accordance with 49 CFR 567. Suppliers shall provide a completed copy of Appendix A and Appendix B with their proposal, providing vehicle specifications and the method of compliance, if any, with each listed section of 49 CFR 571.100.

### **1.2 ZERO EMISSION VEHICLE (ZEV) CERTIFICATION**

Vehicles shall be certifiable under current California Air Resources Board (CARB) regulations as vehicles that meet ZEV emission requirements and qualify for ZEV credits. If the vehicle is equipped with a fuel-fired heater, the heater shall also comply with this requirement.

### **1.3 SAFETY FEATURES**

Suppliers should describe safety measures and safety-related design features included in their vehicle design and provide an explanation of the purpose and anticipated effect on vehicle reliability and performance of any such safety measure or design feature.

### **1.4 MATERIAL SAFETY DATA SHEETS**

Suppliers shall provide Material Safety Data Sheets (MSDS) for all unique hazardous materials supplied with the vehicle.

### **1.5 BATTERY AND OTHER HAZARDOUS MATERIAL RECYCLING PLANS**

Suppliers shall provide recycling plans for batteries and other vehicle hazardous materials including how the plan has been implemented. This plan should also identify post-purchase costs associated with recycling that will be passed on to the vehicle purchaser.

### **1.6 FEDERAL COMMUNICATIONS REQUIREMENTS**

All vehicles shall comply with the FCC requirements for unintentional emitted electromagnetic radiation, as identified in 47 CFR 15, Subpart B, "Unintentional Radiators."



## **2.0 CHASSIS**

### **2.1 RATED PAYLOAD**

Vehicles shall have a minimum payload of at least 400 pounds.

### **2.2 CURB WEIGHT AND GROSS VEHICLE WEIGHT RATING (GVWR)**

Suppliers shall provide the curb weight and rated payloads of their vehicles. For conversion vehicles, Suppliers shall specify the OEMs gross vehicle weight rating (GVWR) and shall not exceed such rating.

### **2.3 VEHICLE WEIGHT DISTRIBUTION**

For conversions, OEM Gross Vehicle Axle Weight Ratings (GAWR) shall not be increased. Suppliers shall provide axle weights for the vehicle as delivered, and at full rated payload.

### **2.4 SPEEDOMETER AND ODOMETER**

Speedometers should be provided and should have an accuracy of at least  $\pm 5\%$  at 20 mph. Odometers shall be provided and shall have an accuracy of at least  $\pm 5\%$ .

### **2.5 BRAKING AND STEERING PERFORMANCE**

Braking and steering efforts for converted vehicles should be similar to OEM models of comparable size and weight.

### **2.6 TIRES**

The Supplier shall offer a standard or an optional tire conforming to the following requirements:

- Tires provided shall correspond to the requirements of the placard installed in accordance with 49 CFR 571.109, and 110, as applicable.
- Suppliers shall specify manufacturer, model and size of the standard tire for the vehicle and for the tire provided.
- Tire size and inflation pressure for the tire provided shall be in accordance with the requirements of the placard.
- At no time shall the tire's inflation pressure exceed the maximum pressure molded into that tire's sidewall.
- The tire provided shall be operable across the entire operation/load range of that vehicle.

**2.6 TIRES (continued)**

- Replacements for the tire provided shall be commercially available to the end user in sufficient quantities to support the purchaser's needs.
- Tires provided as original equipment by the Supplier shall not have warranty restrictions in excess of those of the tire's manufacturer, unless the Supplier provides the warranty for the tires.

**2.7 GROUND CLEARANCE**

Vehicles should have a ground clearance of at least five (5) inches to all sprung and unsprung portions of the vehicle, with the vehicle loaded with rated payload (e.g. to GVWR).

### **3.0 VEHICLE CHARACTERISTICS**

#### **3.1 SEATING CAPACITY**

Seating capacity shall be a minimum of 1 driver. Seating should allow for at least one passenger. Suppliers shall specify seating capacity (available seat belt positions) for their vehicle. If a conversion vehicle's seating capacity is changed from that specified by the OEM on their FMVSS placard, the seat(s) being added or abandoned shall be modified as required by 49 CFR 571.207, et al, and a new FMVSS placard installed as required by 49 CFR 567, 568 or 571, as applicable.

#### **3.2 PASSENGER AND CARGO SPACE**

Suppliers should specify interior passenger and cargo dimensions/volumes and should describe weatherizing provisions for passenger and cargo spaces. For conversion vehicles, the OEM passenger space shall not be intruded upon by the batteries or other conversion materials.

#### **3.3 ELECTROMAGNETIC SUSCEPTIBILITY**

Vehicles should comply with the relevant sections of SAE J551 for electromagnetic radiated fields. Vehicles should not be susceptible to externally generated electromagnetic radiation from an on-board transmitter (i.e., interaction will not preclude operation of any systems required for proper operation of the vehicle).

Vehicles should comply with the relevant sections of SAE J551 for susceptibility to electromagnetic fields. Vehicles should not be susceptible to externally generated electromagnetic radiation from an on-board radio transmitter (i.e., interaction will not preclude operation of any system(s) required for proper operation of the vehicle).

## **4.0 DRIVE SYSTEM**

### **4.1 TRANSMISSION**

The vehicle may utilize a single speed or multi-speed automatic or a Continuously Variable Transmission.

### **4.2 REGENERATIVE BRAKING SYSTEM**

Regenerative braking shall not adversely impact the vehicle's service brake capability on varying road surfaces. Suppliers should describe the operation of the regenerative braking system and its interface with service brake and anti-lock brake systems.

### **4.3 OVERHEATING**

The vehicle drive train system should be capable of continuous operation at maximum vehicle speed without overheating or loss of component life over the range of ambient temperatures specified in Section 5.6.

### **4.4 BATTERY DISCHARGE LIMIT**

The controller/inverter shall limit the maximum battery discharge to prevent degradation of battery life (see Section 6.3) and abrupt loss of vehicle operability or shall indicate to the vehicle operator that the battery will be damaged by continued vehicle operation. Such limit and/or indication shall be repeatable and accurate to at least 10% battery state of charge. Suppliers should specify the battery voltage limits and describe how these limits are implemented.

### **4.5 DRIVE TRAIN**

Drive train components should not produce or develop unusual vibrations over the entire design speed range of the vehicle.

### **4.6 PARKING BRAKE**

Vehicles shall comply with the requirements of 49 CFR 571.105.S5.2.1, or alternatively, 49 CFR 571.105.S5.2.2 for parking mechanisms.

## **5.0 VEHICLE PERFORMANCE**

### **5.1 ACCELERATION**

The vehicle should have a 0-20 mph acceleration time of 6.0 seconds or less when operated with a payload of 332 pounds, and starting with the battery at a 50% state of charge.

### **5.2 TOP SPEED**

The vehicle should have a minimum top speed of 20 mph when loaded with a payload of 332 pounds and starting with the battery at a 50% state of charge. The vehicle top speed shall not exceed 25 mph when tested in accordance with 49 CFR 571.500.

### **5.3 CONSTANT SPEED RANGE**

The vehicle should have a minimum 25 mile range when operated at constant top speed with a payload of 332 pounds, and starting with the battery at a 100% state of charge.

### **5.4 HIGH SPEED GRADEABILITY**

Vehicles should achieve a minimum sustainable speed of 20 mph when loaded with a payload of 332 pounds on a 6% grade, starting with the battery at 50% state of charge.

### **5.5 LOW SPEED GRADEABILITY**

Vehicles should be capable of starting and ascending a 25% grade when loaded with a payload of 332 pounds and starting with the battery at a 50% state of charge.

### **5.6 DURABILITY**

Vehicles shall be capable of completing the NEV America Rough Road Test NTP-005 Revision 1 including (1) driving through two (2) inches of standing water at a speed of 20 mph without damage and without battery to chassis leakage current exceeding 0.5 MIU per UL Standard 2202, and (2) standing for extended periods in extreme temperatures without damage to or failure of the vehicle or its systems. Vehicles should be capable of completing the NEV America Rough Road Test NTP-005 Revision 1 without becoming inoperable. Vehicle shall be capable of completing all NEV America tests without repairs exceeding a cumulative total of 72 hours.

### **5.7 OUT OF SERVICE ENDURANCE**

Beginning full charge, vehicles should be capable of operating and charging after being out of service in an ambient temperature between 40°F and 120°F and off charge for 16 days. No operator action should be required during this period

## **6.0 BATTERY SYSTEMS**

### **6.1 BATTERY TYPE**

Suppliers should provide a detailed description of the battery pack (including specific energy, specific power and discharge capacity to 80% DOD at the one-hour and three-hour rates), battery pack voltage, number of battery modules, and a summary of previous battery performance tests. Summary results of actual performance tests or computer simulations of the proposed battery should also be provided.

### **6.2 BATTERY CHARACTERISTICS**

Batteries should comply with the requirements of SAE J1718. For valve regulated batteries, the internal pressure level at which batteries vent should be specified. Suppliers should describe projected charge cycles at a specified level of discharge, how battery life is maximized, how end of life of each battery module and of the full battery pack is determined and how battery temperature gradients are minimized.

Batteries should comply with the requirements of NEC 625 and UL-2202 for charging in enclosed spaces without a vent fan. The vehicle should be labeled as not requiring ventilation for charging (or have the appropriate classification label from a UL-recognized Testing Laboratory). If vehicle batteries require active ventilation for charging, the vehicle shall be so marked.

### **6.3 MAXIMUM STATE OF DISCHARGE**

Suppliers shall indicate the depth of discharge below which the batteries should not be discharged. This should include the specific parameters the controller/inverter utilizes to prevent over-discharge. Ah rating(s), module voltage(s), and battery pack voltage(s) should be provided. Further, this should be consistent with information provided in the Owner's Manuals.

### **6.4 BATTERY PACK**

Suppliers should specify the weight of each battery module, and the weight of the battery pack (including removable pack structures). Suppliers should describe how batteries are installed in the vehicle (including details of module connection), the method of installation and removal of the batteries (and the battery box, if required) for maintenance and repair, the time required for battery removal and any special training, tools or equipment required for battery removal.

**6.5 ELECTROLYTE CONTAINMENT**

Batteries and/or battery enclosures should comply with the requirements of SAE J1766 and should be designed and constructed in such a way that batteries and electrolyte will not intrude into the passenger compartment during or following roll-over requirements of 49 CFR 571.301. Further, vehicles should comply with the requirements of 49 CFR 571.305. Suppliers shall provide a description of areas of non-compliance (if any) with the requirements of this Section 6.5.

**6.6 BATTERY PACKAGING**

Vehicles should comply with SAE J1797 for packaging of battery modules.

**6.7 BATTERY BOX**

Concentrations of explosive gases in the battery box shall not be allowed to exceed 25% of the LEL (Lower Explosive Limit). Suppliers shall describe how battery boxes will be vented, to prevent battery gas accumulation during and following normal charging, abnormal charging and operation of the vehicle. Suppliers shall provide a description of areas of non-compliance (if any) with the requirements of SAE J1718 APR97 on Battery Gas Evolution.

**6.8 PARALLEL BATTERY PACKS**

If a Supplier provides a vehicle with parallel battery packs, the Supplier should provide detailed information on the equipment and charging algorithms required to prevent the parallel strings from becoming unbalanced.

**6.9 BATTERY MAINTENANCE**

Maintenance requirements for the batteries shall be described and any associated cost(s) to the consumer/end user should be clearly defined.

**6.10 BATTERY CHARGING ALGORITHM**

Suppliers should verify that the method(s) of charging and the charging algorithm(s) do not impact the battery warranties available to end-user from either the vehicle Supplier or the battery manufacturer, if the battery manufacturer warrants the battery.

## **7.0 ELECTRICAL**

### **7.1 ELECTRICAL SAFETY**

Vehicles shall not contain exposed conductors, terminals, contact blocks or devices of any type that create the potential for personnel to be exposed to 60 volts (nominal battery voltage) or greater (the distinction between low-voltage and high voltage, as specified in SAE J1127, J1128, et al.). Access to any high voltage components shall require the removal of at least one bolt, screw, cover, or latch. Devices considered to be high voltage components shall be clearly marked as HIGH VOLTAGE. These markings should be installed at any point the voltage can be accessed by the end user. Additionally, cable and wire marking shall consist of orange wire and/or orange sleeves as identified in SAE-J1127.

### **7.2 ELECTRICAL ISOLATION**

Propulsion power system operating at greater than 60 volts shall be isolated from the vehicle chassis such that leakage current does not exceed 0.5 MIU.

Charging circuits shall be isolated from the vehicle chassis such that ground current from the grounded chassis does not exceed 5 mA at any time the vehicle is connected to an off-board power supply and shall be compatible with operation using a 5 mA GFCI.

Supplier should provide details on grounding and isolation methods.

### **7.3 BATTERY DISCONNECT**

Vehicles using HIGH VOLTAGE traction systems shall be equipped with a key operated “master” switch that shall interlock controller propulsion functions and battery contactor(s), if any, to render the propulsion system inoperative. Contactor(s) used in conjunction with the master switch shall be capable of interrupting maximum rated controller/inverter current.

A manual service disconnect for vehicles using a HIGH VOLTAGE traction system shall also be required. It shall have the following characteristics:

- Manual action is required to break the connection,
- The disconnection is physically verifiable,
- The disconnection does not create exposed conductors capable of becoming energized while exposed, and
- The service disconnect is marked in a manner meeting the requirements for visibility and labeling denoted in 49 CFR 565 for VIN labels and is accessible without the use of tools.



#### **7.4 SAFETY INTERLOCK SYSTEM**

The following controller/inverter interlocks shall be present:

- The controller shall not initially energize to move the vehicle with the direction selector in any position other than “PARK” or “NEUTRAL;”
- The master switch key shall be removable only when the switch is in the “OFF” position,
- With a pre-existing accelerator input, the controller shall not energize such that the vehicle can move under its own power in this condition.

The vehicle shall be prevented from being driven with the master switch key turned on and the drive selector in the drive or reverse position while the vehicle’s charge cord is attached.

#### **7.5 OPERATION OF LIGHTS**

Hazard lights should be capable of at least one hour of continuous operation in the event of shutdown or isolation of the propulsion battery pack or failure of the DC/DC converter system as described in SAE J590b.

Turn signals required by 49CFR571.500 should be self-canceling and provided as standard or optional equipment.

#### **7.6 STATE OF CHARGE INDICATOR**

The vehicle should include a state of charge indicator for the propulsion battery. Indications should be repeatable and accurate to  $\pm 10\%$  of full scale.

#### **7.7 CONNECTORS**

Low voltage connectors should comply with the requirements of applicable SAE Standards, including J163, J561, J858, et al. HIGH VOLTAGE connectors should utilize locking devices, should be keyed to prevent mis-connection, and should be moisture proof.

#### **7.8 WINDSHIELD WIPERS**

Electrically powered windshield wipers shall be provided as standard or optional equipment.

#### **7.9 WARNING HORN**

An electrically powered warning horn operable by the vehicle driver shall be provided as standard or optional equipment.

## **8.0 CHARGER SYSTEM**

### **8.1 CHARGER OPERATION**

Vehicles shall be equipped with an on-board or off board battery charger capable of recharging the propulsion battery to a state of full charge from any possible state of discharge in less than 12 hours.<sup>1</sup> Recharge time should be less than eight (8) hours.

The charger should maintain each battery module at a consistent state of charge over the life cycle of the battery. The charger should not charge the batteries in a manner that would cause venting of gas. The charger shall be fully automatic, determining when “end of charge” conditions are met and transitioning into a mode that maintains the propulsion battery at a full state of charge while not overcharging it, if continuously left on charge. The charger should also minimize the energy required to maintain the propulsion battery in a fully charged state, particularly during extended periods on charge.

### **8.2 CHARGING INPUT POWER**

On-board and off board chargers shall have the capability of accepting input voltages of 120V (Level 1), 208V or 240V (Level 2) single phase 60 Hertz alternating current service, with a tolerance of  $\pm 10\%$  of rated voltage. On-board charger personnel protection systems, which may include ground fault circuit interrupters (GFCI), shall be in accordance with the provisions of UL Standard 2202.

### **8.3 FAST CHARGING**

Vehicles should be equipped with a fast charge connection that allows the propulsion battery to be returned to 80% state of charge from any possible state of discharge in less than 30 minutes. The fast charge connection shall allow the use of a fast charge connector listed by UL for electric vehicle service.

### **8.4 VEHICLE CHARGER CONNECTIONS**

Suppliers should describe the type, size and location of the point of the vehicle charging port. Level 2 charge connector shall comply with the requirements of UL Proposed Standard 2251. Regardless of the charger type used, the charger shall conform to the requirements of UL Proposed Standard 2202.

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<sup>1</sup> Other certifying or qualifying agencies, such as California’s South Coast Air Quality Management District (SCAQMD) and the California Energy Commission (CEC), may have requirements for charging times that differ from NEV America. Should Suppliers wish to be considered under those qualification and/or incentive programs using NEV America data, those entities should be consulted.

## **9.0 OPTIONS**

Suppliers shall specify all optional equipment required to meet the requirements of this Vehicle Specification. Suppliers should describe the following options, if available. The installation of options shall not relieve Suppliers of complying with other “shall” requirements (except for range). Suppliers should specify the impact on range and payload for each option.

### **9.1 PASSENGER COMPARTMENT HEATER**

Suppliers should describe the design feature(s) that ensure the vehicle heating system is capable of maintaining interior temperatures of at least 65°F at an ambient temperature of 10°F. If fuel fired heaters are used, they shall comply with the requirements of Section 1.2. Further, fuel fired heaters should comply with the requirements of 49 CFR 571.301.

### **9.2 AIR CONDITIONING SYSTEM**

Suppliers should describe the design of the air conditioning system and verify that it uses no chloroflourocarbons (CFCs).

### **9.3 OCCUPANT COMPARTMENT PRE-HEATING AND PRE-COOLING SYSTEM**

Suppliers should briefly describe the design of a pre-heating and pre-cooling system that allows passenger compartment temperatures to be maintained while the vehicle is on charge.

### **9.4 COLD WEATHER RANGE EXTENSION**

If the vehicle is equipped with a range extension system for operation in cold weather, the Supplier should describe the design of the system. This system should operate concurrent with the charging system, and should not require the use of additional connection points. It should not require manual intervention, and should operate at all input voltages for which the charger is rated

## **10.0 DOCUMENTATION**

### **10.1 SERVICE MANUALS**

Vehicles shall be accompanied by non-proprietary manuals for parts, service, operation and maintenance, interconnection wiring diagrams and schematics. Manuals should include details on the design and operation of vehicle systems, as well as a list of additional or special maintenance tools required.

### **10.2 TRAINING PROGRAM**

Suppliers should offer a training program for the purchaser's maintenance personnel covering vehicle safety and proper operation and maintenance of vehicles.

## APPENDIX A

### PERFORMANCE

Time required to accelerate from 0-20 on a level grade (s) \_\_\_\_\_  
Time required to accelerate from 0-20 on a 3% grade (s) \_\_\_\_\_  
Time required to accelerate from 0-20 on a 6% grade (s) \_\_\_\_\_  
Maximum speed attainable on a level grade (mph) \_\_\_\_\_  
Maximum grade attainable from a standing start at GVWR (%) \_\_\_\_\_  
Range at a constant speed of 20 mph (miles) \_\_\_\_\_

### BATTERY CHARACTERISTICS (referenced to 25°C)

Manufacturer \_\_\_\_\_  
Model \_\_\_\_\_  
Type \_\_\_\_\_  
Description \_\_\_\_\_  
Vehicle requires ventilation per NEC 625 and UL-2202 ☐ Yes ☐ No  
Batteries labeled by UL recognized authority as not requiring ventilation ☐ Yes ☐ No  
Vehicle labeled as not requiring ventilation ☐ Yes ☐ No  
Number of Batteries in the Pack \_\_\_\_\_  
Arrangement (series or parallel) \_\_\_\_\_  
Battery module voltage (VDC) \_\_\_\_\_  
Battery pack voltage (VDC) \_\_\_\_\_  
Battery module weight (kg) \_\_\_\_\_  
Battery pack weight (kg) \_\_\_\_\_  
Battery capacity to 100% Manufacturer's DOD, 1 hour rating (Ah) \_\_\_\_\_  
Battery capacity to 100% Manufacturer's DOD, 2 hour rating (Ah) \_\_\_\_\_  
Battery capacity to 100% Manufacturer's DOD, 3 hour rating (Ah) \_\_\_\_\_  
Battery energy to 100% Manufacturer's DOD, 1 hour rating (Wh) \_\_\_\_\_  
Battery energy to 100% Manufacturer's DOD, 2 hour rating (Wh) \_\_\_\_\_  
Battery energy to 100% Manufacturer's DOD, 3 hour rating (Wh) \_\_\_\_\_  
Probable life of an average battery to a Manufacturer's DOD of:  
50% DOD (cycles) \_\_\_\_\_  
80% DOD (cycles) \_\_\_\_\_  
Time required to recharge the batteries from a DOD of:  
50% DOD (cycles) \_\_\_\_\_  
80% DOD (cycles) \_\_\_\_\_  
Maximum recommended DOD \_\_\_\_\_ % \_\_\_\_\_ Ah  
Battery specific power at 0% DOD \_\_\_\_\_

## APPENDIX A (cont)

### CHARGER CHARACTERISTICS

Manufacturer \_\_\_\_\_  
Model \_\_\_\_\_  
UL file number \_\_\_\_\_  
Description \_\_\_\_\_  
Location \_\_\_\_\_  
Charger efficiency at rated load (%) \_\_\_\_\_  
Charger input voltages (VAC) \_\_\_\_\_  
Charger input power factor at rated load (%) \_\_\_\_\_  
Charger input total harmonic distortion at rated load (%) \_\_\_\_\_  
Maximum charger current output at rated power (A) \_\_\_\_\_

### MOTOR CHARACTERISTICS

Manufacturer \_\_\_\_\_  
Model \_\_\_\_\_  
Description \_\_\_\_\_  
Type (AC, DC, Brushless, etc.) \_\_\_\_\_  
Rated Efficiency \_\_\_\_\_ % @ \_\_\_\_\_ kW  
Operating Range (RPM) \_\_\_\_\_  
Maximum Intermittent Power \_\_\_\_\_ kW for \_\_\_\_\_ minutes  
Maximum Continuous Power \_\_\_\_\_  
Cooling Medium and Method \_\_\_\_\_

### CONTROLLER CHARACTERISTICS

Manufacturer \_\_\_\_\_  
Model \_\_\_\_\_  
Description \_\_\_\_\_  
Type and Phase \_\_\_\_\_  
Input Voltage Range \_\_\_\_\_  
Maximum Output (A) \_\_\_\_\_  
Type of Power Electronics (IGBT, mosfet, etc.) \_\_\_\_\_  
Rated Efficiency \_\_\_\_\_ % @ \_\_\_\_\_ A  
Method used to limit maximum battery discharge \_\_\_\_\_

## APPENDIX A (cont)

### TRANSMISSION CHARACTERISTICS

Manufacturer \_\_\_\_\_  
Type \_\_\_\_\_  
Model \_\_\_\_\_  
Description \_\_\_\_\_  
Gear Ratio(s) \_\_\_\_\_

### CHASSIS CHARACTERISTICS (pre-conversion if applicable)

Make, Year and Model \_\_\_\_\_  
Gross vehicle weight rating (kg) \_\_\_\_\_  
Gross axle weight rating (kg) \_\_\_\_\_ front \_\_\_\_\_ rear  
Curb weight (kg) \_\_\_\_\_  
Weight distribution \_\_\_\_\_ % front \_\_\_\_\_ % rear  
Payload capacity (kg) \_\_\_\_\_  
Ground clearance from lowest point on chassis at GVWR (cm) \_\_\_\_\_  
Drive Wheels (F/R) \_\_\_\_\_  
Number of seating positions \_\_\_\_\_

### CHASSIS CHARACTERISTICS (as supplied for testing)

Make, Year and Model \_\_\_\_\_  
Gross vehicle weight rating (kg) \_\_\_\_\_  
Gross axle weight rating (kg) \_\_\_\_\_ front \_\_\_\_\_ rear  
Curb weight (kg) \_\_\_\_\_  
Weight distribution \_\_\_\_\_ % front \_\_\_\_\_ % rear  
Payload capacity (kg) \_\_\_\_\_  
Ground clearance from lowest point on chassis at GVWR (cm) \_\_\_\_\_  
Drive Wheels (F/R) \_\_\_\_\_  
Number of seating positions \_\_\_\_\_  
Passenger area dimension \_\_\_\_\_  
Passenger area volume \_\_\_\_\_  
Cargo area dimensions \_\_\_\_\_  
Cargo area volume \_\_\_\_\_  
Weatherization provisions for passenger and cargo areas \_\_\_\_\_

Wheelbase \_\_\_\_\_ inches  
Track \_\_\_\_\_ inches front \_\_\_\_\_ inches rear  
Body height \_\_\_\_\_ inches  
Body width \_\_\_\_\_ inches

## APPENDIX A (cont)

### BRAKES

Type front \_\_\_\_\_  
Type rear \_\_\_\_\_  
Power source, if used \_\_\_\_\_  
Average power, if used (W) \_\_\_\_\_  
Maximum regenerative braking (kW) \_\_\_\_\_

### TIRES (as tested)

Manufacturer \_\_\_\_\_  
Model \_\_\_\_\_  
Description \_\_\_\_\_  
Size and profile \_\_\_\_\_  
Pressure (psi) \_\_\_\_\_ front \_\_\_\_\_ rear  
Weight capacity (lbs) \_\_\_\_\_  
Are these tires standard equipment ☐ or optional equipment ☐  
Describe warranty term and coverage \_\_\_\_\_  
\_\_\_\_\_

### SUSPENSION

Type front \_\_\_\_\_  
Type rear \_\_\_\_\_  
Modifications made during conversion, if any \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

### STEERING

Type \_\_\_\_\_  
Description \_\_\_\_\_  
Manufacturer \_\_\_\_\_  
Power source, if used \_\_\_\_\_  
Average power, if used (W) \_\_\_\_\_

### AIR CONDITIONING

Description \_\_\_\_\_  
Compressor type \_\_\_\_\_  
Maximum cooling output (BTU/hr) \_\_\_\_\_  
Motor type \_\_\_\_\_  
Maximum power required (kW) \_\_\_\_\_



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**HEATING**

Description \_\_\_\_\_

Type \_\_\_\_\_

Maximum heating output (BTU/hr) \_\_\_\_\_

Maximum power required (kW) \_\_\_\_\_

Certifiable under CARB ZEV requirements Yes ☐ No ☐

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## APPENDIX A (continued)

### REQUIRED SUBMITTALS

- Each Supplier shall acknowledge **in writing** that 1) it is solely responsible for determining whether each vehicle offered for sale is safe, and 2) it is not relying on Electric Transportation Applications or the U.S. Government as having, by this specification and its requirements, established minimally sufficient safety standards.
- Suppliers should describe safety measures and safety-related design features included in their vehicle design and provide an explanation of the purpose and anticipated effect on vehicle reliability and performance of any such safety measure or design feature.
- Suppliers shall supply Material Safety Data Sheets (MSDS) for all batteries the vehicle is equipped with, including auxiliary batteries.
- Suppliers shall provide information on their selected battery manufacturer's recycling plan, including how it has been implemented. This plan should also identify post-purchase costs associated with recycling that will be passed on to the vehicle purchaser.
- Suppliers should specify interior passenger and cargo dimensions/volumes and should describe weatherizing provisions for passenger and cargo spaces.
- Suppliers should describe the operation of the regenerative braking system and its interface with braking and anti-lock brake systems.
- Suppliers should specify the voltage limits which limit the maximum battery discharge and describe how these limits are implemented.
- Suppliers should provide a detailed description of the battery pack (including specific energy, specific power and discharge capacity to 80% DOD at the one-hour and three-hour rates), battery pack voltage, number of battery modules, and a summary of previous battery performance tests. Summary results of actual performance tests or computer simulations of the proposed battery should also be provided.
- Suppliers should describe projected charge cycles at a specified level of discharge, how battery life is maximized, how end of life of each battery module and of the full battery pack is determined and how battery temperature gradients are minimized.
- Suppliers shall indicate the depth of discharge below which the batteries should not be discharged. This should include the specific parameters the controller/inverter utilizes to prevent over-discharge.
- Suppliers should describe how batteries are installed in the vehicle (including details of module connection), the method of installation and removal of the batteries (and the battery box, if required) for maintenance and repair, the time required for battery removal and any special training, tools or equipment required for battery removal.

## APPENDIX A (continued)

- Suppliers shall provide verification of conformance to the requirements of Section 6.5 of UEV America Vehicle Technical Specification Revision 2, January 1, 2003.
- Suppliers shall describe how battery boxes will be vented, to allow any battery gases to escape safely to atmosphere during and following normal or abnormal charging and operation of the vehicle. Suppliers shall provide a verification of conformance to SAE J1718 APR97 on Battery Gas Evolution.
- If a Supplier provides a vehicle with parallel battery packs, the Supplier should provide detailed information on the equipment and charging algorithms required to prevent the parallel strings from becoming unbalanced.
- Suppliers should describe the methods used to prevent or accommodate condensation in the battery box, and the quantity and maximum rate of explosive gas generation, by gas type, under normal and abnormal charging conditions.
- If a Supplier provides a vehicle with parallel battery packs, the Supplier should provide detailed information on the equipment and charging algorithms required to prevent the parallel strings from becoming unbalanced.
- Maintenance requirements for the propulsion batteries should be described and any associated cost(s) to the consumer/end user should be clearly defined.
- Suppliers should verify that the method(s) of charging and the charging algorithm(s) do not impact the battery warranties available to end-user from either the vehicle Supplier or the battery manufacturer, if the battery manufacturer warrants the battery.
- Suppliers should provide details on grounding and isolation methods.
- Suppliers should describe the type, size and location of the point of the vehicle charging port.
- Suppliers should describe the following options (if available);
  - Passenger compartment heater
  - Air conditioning system
  - Occupant compartment pre-heating and pre-cooling system
  - Cold weather range extension
- Vehicles shall be accompanied by non-proprietary manuals for parts, service, operation and maintenance, interconnection wiring diagrams and schematics, (with pricing for optional manuals).

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49 CFR 571	METHOD OF ACHIEVING COMPLIANCE			
	OEM Certified	Vehicle Test	Analysis Only	Not Certified
102 - Transmission Shift Lever Sequence, Starter Interlock & Transmission Braking Effect				
104 - Windshield Wiping and Washing Systems				
105 - Hydraulic Brake Systems				
106 - Brake Hoses				
108 - Lamps, Reflective Devices, and Associated Equipment				
109 - New Pneumatic Tires				
110 - Tire Selection and Rims				
111 - Rearview Mirrors				
116 - Motor Vehicle Brake Fluids				
124 - Accelerator Control Systems				
125 - Warning Devices				
205 - Glazing Materials				
209 - Seat Belt Assemblies				
210 - Seat Belt Assembly Anchorages				
301 - Fuel System Integrity				